A Guide to Using the "Approved Model" (April 15, 2011) When Submitting a Modified Generic Risk Assessment (MGRA)

PIBS # 8450e

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A Guide to Using the "Approved Model" When Submitting a Modified Generic Risk Assessment (MGRA)

The following is a suggested step-by-step guide for using the "Approved Model" when submitting a modified generic risk assessment (MGRA) to the Ministry of the Environment for review. The "Approved Model" in this form will apply to the submission of MGRAs from July 1, 2011 until the "Approved Model" is amended and replaced by a web-based Tier 2 version.

Although the Approved Model is relatively user friendly, there are some aspects for which guidance may assist the user considerably in generating appropriate site condition standards.

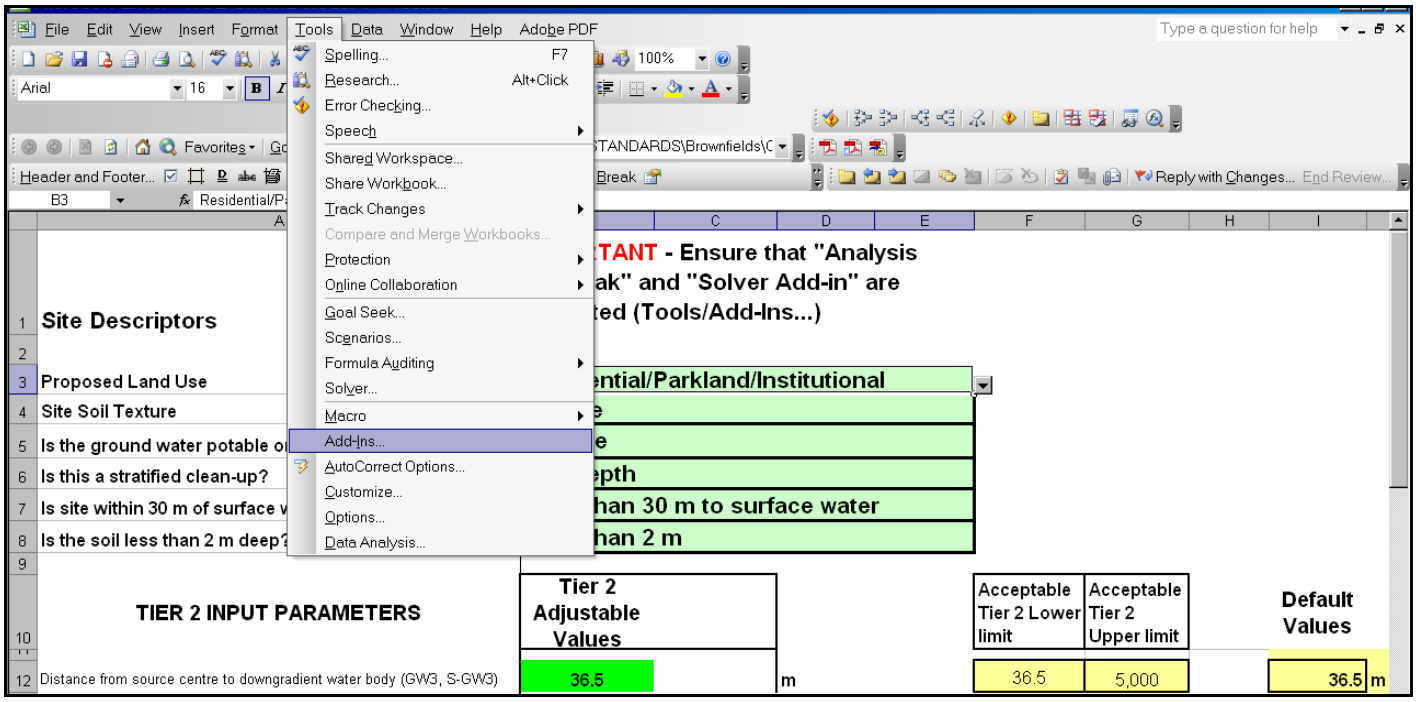
The guide below assumes that a QP has already conducted or supervised and completed phase one and two environmental site assessments (ESAs) in accordance with the requirements of O. Reg. 153/04 (the "Regulation"), excluding requirements related to work following the acceptance of a risk assessment. Any work needed to modify an assumption within the model must be done in accordance with the Regulation (i.e. sections 41, 42 and Table 4 of Schedule E of the Regulation). Of course, the "Approved Model" may be used at various stages of a RA for other purposes.

Downloading and Setting up the Model

1. The "Approved Model" can be downloaded from the following website. The model is designed to work on Microsoft Excel 2003 (or later). MOE cannot assure users that results from its use on other programs will be the same as those produced by Excel.
   http://www.ene.gov.on.ca/environment/en/subject/brownfields/STDPROD_075745.html

   An Open Office Calc version that has been checked for errors may also be made available; however, formatting of this version is in scientific notation such that rounding can be to two digits.

2. Be sure that "Analysis Tool Pak" and "Solver Add -in" are installed in Excel
   - go to Tools – Add-Ins, then check the appropriate boxes, and click OK

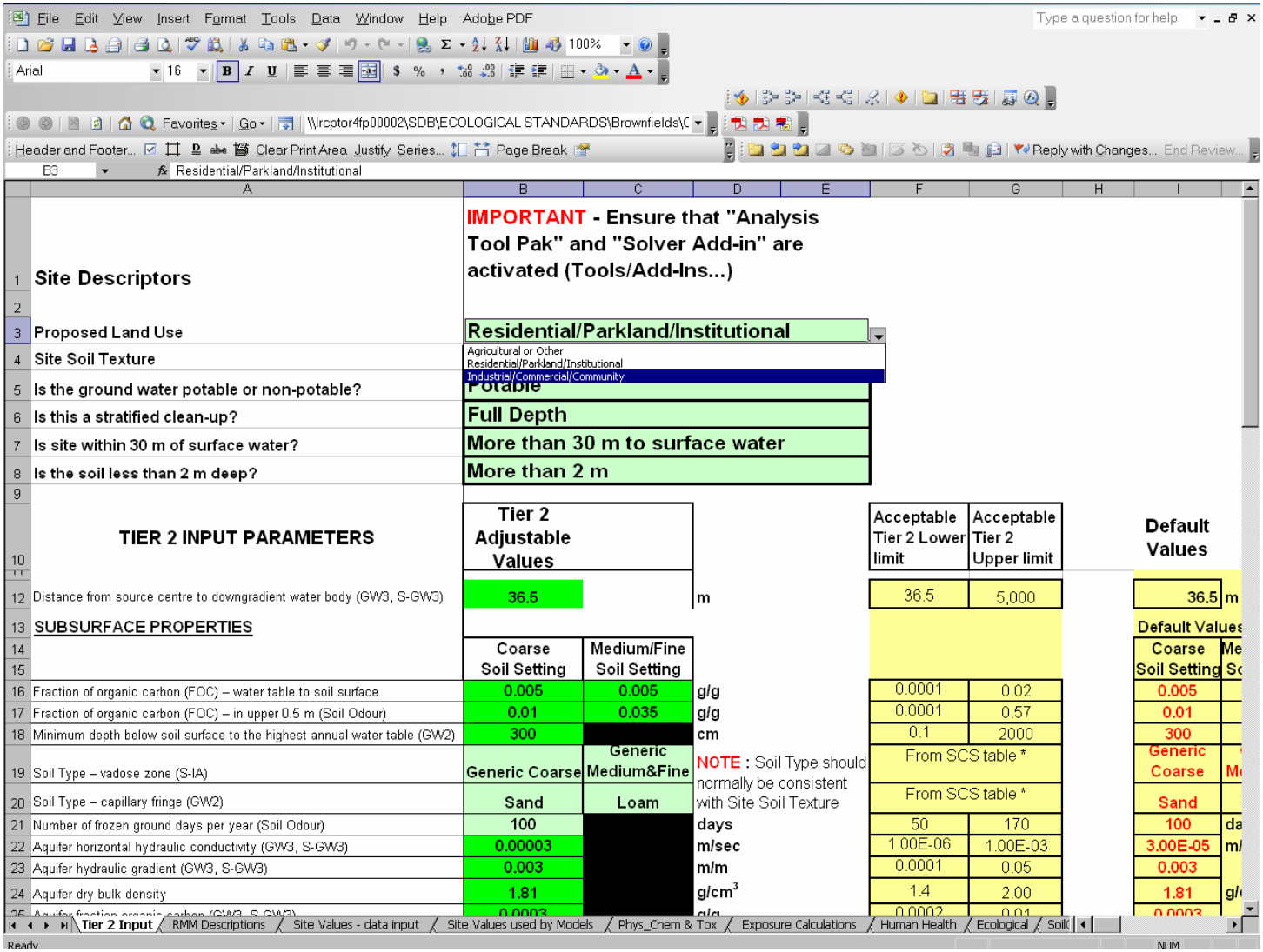


Running the Model

1. Open “Approved Model” and click on the “Tier 2 Input “ tab

The cells that are highlighted in either of the two green shades are cells where the user can input information. The bright green shaded cells are for direct numeric user input, and the lighter (or duller) green shaded cells have pull down menus that pop up when the arrow on the right side of the box is clicked.

Check Site Descriptors in cells B3-B8 to be sure that the descriptions match the site in question. To change a description, click on the appropriate cell, then click on the down arrow on the right end of the box and choose the description that is appropriate for the site. Explanations of these site descriptors are available in the document “Records of Site Condition: A Guide on Site Assessment, the Cleanup of Brownfield Sites and the Filing of Records of Site Condition“, which can be found at http://www.ene.gov.on.ca/environment/en/subject/brownfields/STDPROD_075745.html (4728e.pdf)



	A	B	C	D	E	F	G	H	I
1	**Site Descriptors**	**IMPORTANT - Ensure that "Analysis Tool Pak" and "Solver Add-in" are activated (Tools/Add-Ins...)**							
2									
3	Proposed Land Use	Residential/Parkland/Institutional							
4	Site Soil Texture	Agricultural or Other / Residential/Parkland/Institutional / Industrial/Commercial/Community							
5	Is the ground water potable or non-potable?	Potable							
6	Is this a stratified clean-up?	Full Depth							
7	Is site within 30 m of surface water?	More than 30 m to surface water							
8	Is the soil less than 2 m deep?	More than 2 m							
9									
10	**TIER 2 INPUT PARAMETERS**	**Tier 2 Adjustable Values**				**Acceptable Tier 2 Lower limit**	**Acceptable Tier 2 Upper limit**		**Default Values**
12	Distance from source centre to downgradient water body (GW3, S-GW3)	36.5		m		36.5	5,000		36.5 m
13	SUBSURFACE PROPERTIES								Default Values
14		Coarse Soil Setting	Medium/Fine Soil Setting						Coarse Soil Setting Me
15									
16	Fraction of organic carbon (FOC) – water table to soil surface	0.005	0.005	g/g		0.0001	0.02		0.005
17	Fraction of organic carbon (FOC) – in upper 0.5 m (Soil Odour)	0.01	0.035	g/g		0.0001	0.57		0.01
18	Minimum depth below soil surface to the highest annual water table (GW2)	300		cm		0.1	2000		300
19	Soil Type – vadose zone (S-IA)	Generic Coarse	Generic Medium&Fine	NOTE : Soil Type should normally be consistent with Site Soil Texture		From SCS table *			Generic Coarse M
20	Soil Type – capillary fringe (GW2)	Sand	Loam			From SCS table *			Sand
21	Number of frozen ground days per year (Soil Odour)	100		days		50	170		100 da
22	Aquifer horizontal hydraulic conductivity (GW3, S-GW3)	0.00003		m/sec		1.00E-06	1.00E-03		3.00E-05 m/
23	Aquifer hydraulic gradient (GW3, S-GW3)	0.003		m/m		0.0001	0.05		0.003
24	Aquifer dry bulk density	1.81		g/cm^3		1.4	2.00		1.81 g/
25	Aquifer fraction organic carbon (GW3, S-GW3)	0.0003		g/g		0.0002	0.01		0.0003

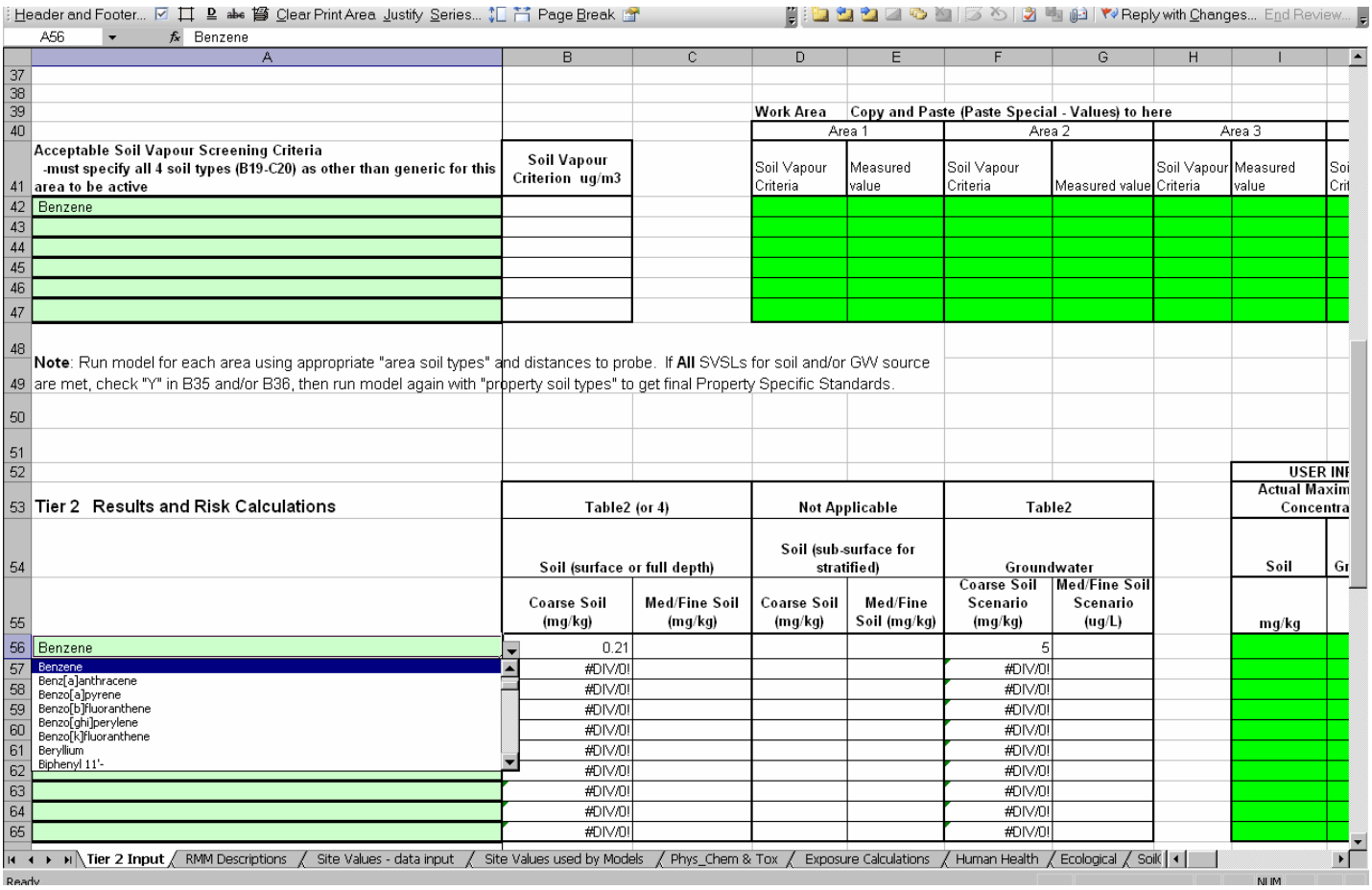
Tier 2 Input | RMM Descriptions | Site Values - data input | Site Values used by Models | Phys_Chem & Tox | Exposure Calculations | Human Health | Ecological | Soil

2. Once all the site descriptors match those appropriate for the site, start entering the relevant site data in cells B12 – B26. If the data entered is outside of the acceptable range (cells in yellow, F12-G26) a warning will pop up. The Tier 1 default values are given in cells I12 to J26 (also in yellow highlight), and once a value changes from the default, it is displayed in *italics*. For sites where the overall soil texture is fine-medium, be sure to enter the appropriate data in Cells C16 and C17. You may leave the default values for the soil texture not used. Note that cells B19-C20 and B21 are changed using the pull down menus to choose the appropriate soil type or frozen days. For determination of the **Soil Type**, use the measured sand, silt and clay contents from the site in conjunction with the information in **Appendix 1** of this document. At this stage, be sure to enter the appropriate value for the "**Property Soil Type**", as opposed to "**Area Soil Type**". For determination of which value to use for **Frozen Ground Days**, follow the requirements set out in ss. 41, 42 and Table 4, Schedule E of O. Reg 153/04, and round it to the nearest tens or use the maps included in **Appendix 2** of this document. When using Appendix 2, if it is uncertain as to which of two zones your site

falls, use the highest of the two numerical values.

Note that none of the four cells (B19-C20) for Soil Type can include either of the terms “Generic Coarse” or “Generic Medium/Fine” if you want the soil vapour screening levels (SVSLs) to be calculated. These two Soil Types are not options for Tier 2 when soil vapour screening levels are desired. There should be a reasonable correspondence between the Soil Types and the Site Soil Texture, or the QP should have a full understanding and explanation as to the reasons why they do not correspond reasonably well. All Phase Two ESA requirements for MGRA should follow sections 41, 42 and Table 4 of Schedule E of the regulation.

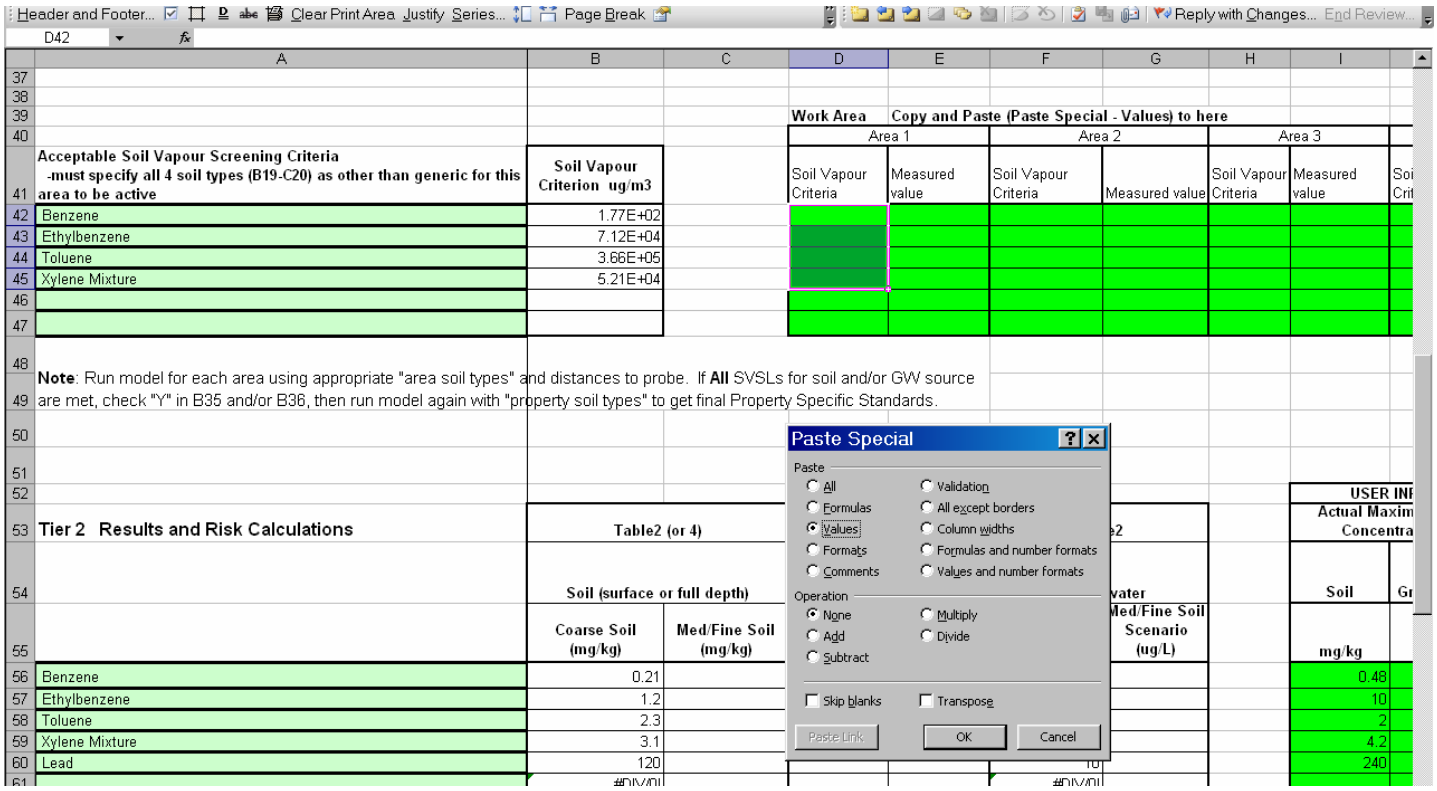
3. After all the available tier 2 properties have been inputted, you may wish to take a look at the results that the spreadsheet has generated and compare them with the maxima measured on the site. To do this, click on Cell A 56 and then click on the down arrow at the right end of the cell and choose a chemical identified as a Contaminant of Concern (CoC) at the site. Repeat in cells A57-A65 for all CoCs on site. (Note - This spreadsheet allows for 10 CoCs, but if you have more than 10 contaminants on the site, you can run the model again for the remainder of the CoCs). The initial soil and ground water criteria generated by the spreadsheet will appear in cells B56-G65.



4. Your actual (measured) site concentrations for soil and ground water can be added to the spreadsheet in cells I56-J65, and your calculated reasonable estimate of the site maximum can be inputted into Cells K56-L65. Note that the estimate of the site max cannot exceed 1.2 times the actual measured site max (a warning will pop up if it does). If for all CoCs none of the measured concentrations (I56-J65) exceed the respective values calculated by the spreadsheet (B56-G65), then your site meets the appropriate Tier 2 **"Property Specific Standards"** (PSSs), and you may submit the risk assessment to the Ministry for approval. **The PSSs that you can use for RSC purposes are displayed in Cells B72-D81**

5. If any of the measured concentrations (I56-J65) of volatile chemicals exceed the respective values calculated by the spreadsheet (B56-G65), and if you have conducted soil vapour measurements, then you can calculate soil vapour screening levels and compare them to your actual soil vapour measurements. Make sure that you fulfilled all the requirements in Appendix 1. In addition, the top of the screening interval of the soil vapour probes should be located at least 0.3 m below the lowest point of the foundation. Begin by entering the names of the volatile chemicals for which soil vapour measurements are available into cells A42-A47, and entering the depth to soil vapour measurement (B26) and the corresponding area soil type – vadose zone (B19 or C19) for one of the soil vapour sampling locations on the site where soil vapour measurements were made. The soil vapour screening levels, appropriate for the soil vapour sampling location at a given depth to soil vapour measurement and to the site inputs currently in the spreadsheet, will then appear in cells B42-B47 (that is, if the Area Soil Type cells (B19-C20) do not contain either of the two generic Soil Types). These soil vapour criteria are specific to the particular soil vapour sampling location and depth from which the soil vapour samples were taken, and which is represented by the current Tier 2 input data that you have entered in the spreadsheet. Be sure to separate areas that are ground water source areas from those that are soil source areas such that you can choose the appropriate measures in cells B35 or B36 later. Repeat this process as many times as needed. You need to develop soil vapour screening levels for each sampling location and depth to soil vapour measurement (as specified in Table 4, Schedule E of the regulation) in which soil vapour measurements were taken at the RA property.

6. Therefore, after checking to be sure that the input parameters (especially soil type and depth to soil vapour measurement (B26)) are correct for that specific soil vapour sampling location, copy the soil vapour screening level criteria (Cells B42-B47) to Cells D42 to D47 (highlight cells to be copied, right click, choose copy, move pointer to D42, right click, choose "**Paste Special**", then "**Values**"(this last part is **critical,** otherwise you will get formulae rather than numbers, or you may alter the formatting!).



7. Now type in the maximum soil vapour measurement recorded for that specific soil vapour sampling location and depth to measurement for the appropriate chemical in cells E42-E47. If a maximum measured concentration exceeds the soil vapour screening level, it will be highlighted in red.

8. Revise the Soil Type – Vadose Zone and the Depth to Soil Vapour Measurement to be in accordance with the identified characteristics for the next soil vapour sampling location and depth where soil vapour samples were taken and repeat steps 7 & 8 putting the results in the section of the spreadsheet for “Area 2”. Then repeat for other sampling locations. (This spreadsheet allows for up to 4 sampling locations at a time)

9. If, for a given CoC, all soil vapour measurements at all the required sampling locations and depths meet the appropriate calculated soil vapour screening levels, then you may change the value in cells B35 and/or B36 (soil vapour screening levels are met), as appropriate for the source of the soil vapours, to a “Y” (on the pull down menu). In most cases this effectively allows for the removal of the S-IA and the GW2 pathways from the Tier 2 PSSs. You will have to keep track as to which CoCs meet the soil vapour screening levels, and be sure to use the results from checking “Y” in B35 or B36 only for those CoCs that meet the soil vapour screening levels. One can then uncheck the “Y” to derive the PSS for those CoC’s which do NOT meet the soil vapour screening level. Before determining your PSSs, you must now go back and re-enter the “Property-wide Soil Types”. If at this point all your maximum measured concentrations at the site meet the calculated criteria in cells B56-G65, then your site

meets the appropriate Tier 2 PSSs, and you may submit the risk assessment to the Ministry for approval. **The "Property Specific Standards" that you can use for RSC purposes are displayed in Cells B72-D81.**

10. If your site still doesn't meet the Tier 2 standards, then you may wish to take a look at the Tables of Drivers (see screen shot below) to determine which component is limiting the PSS value. To do this, at the bottom of the spreadsheet find the appropriate "Table of Drivers" tab (soil or water), click on it, and then find the appropriate Table of Standards, Soil Texture, and Land Use (Soils only) in rows 1 and 2. Scroll down to the CoC of interest, and determine which component is highlighted. The highlighted cell indicates the driving component (note that if this component is below the reporting limit or the background concentration they are also highlighted, and the criterion is bumped up to the higher value). You may wish to note both the driving component and the next lowest component value (the second driver) and compare both with your CoC concentration. Short descriptions of all the components are given at the end of Appendix 3.

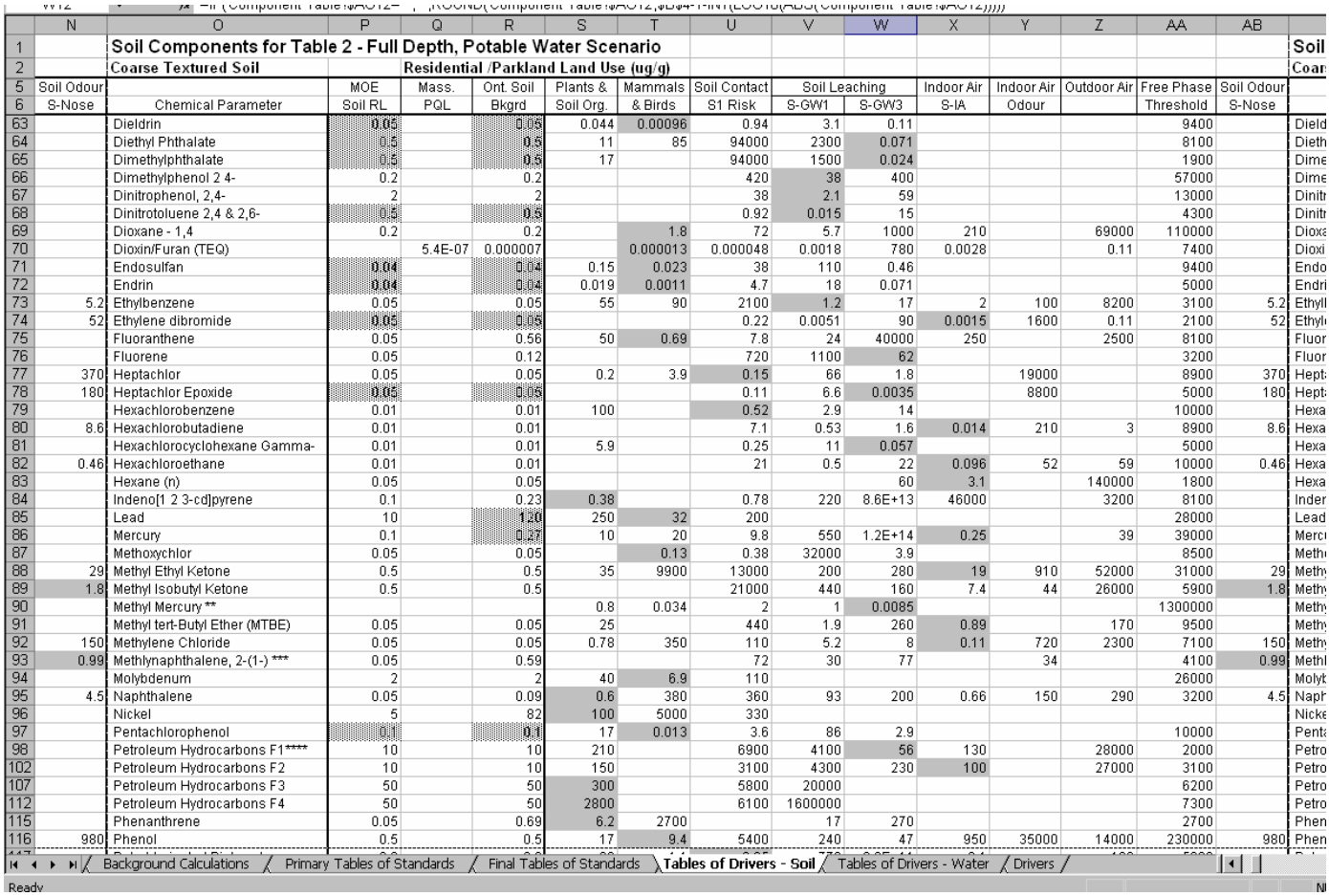
    If there are site properties described in cells A12 –A26 of the Tier 2 Input tab for which no measurements have been conducted, you may wish to check **Appendix 3** to determine if you can benefit from measuring them and using them in the Tier 2 process. The possibility of producing a less stringent Tier 2 number exists if there is a check mark in Appendix 3 against the measured parameter for the particular driver that is driving your PSS. The following general guide may be of assistance for determining how the Tier 2 can proceed from this point.

    No Possibility of Change in Tier 2
    – S3, GW1, Solubility

    Change from Measured Parameters (see Appendix 3)
    – S-IA, S-Odour, S-GW1, S-GW3, S-OA, GW2, GW3, Free Phase Threshold
    – Note that SVSL measurements could affect S-IA and GW2

    Change from Modified Ecological Protection Pathway Modification, no CPU (step 11)
    – Plants and Soil Invertebrates, Mammals and Birds.

    Change from Risk Management, CPU (see steps 12 to 14)
    – S-IA, S-IA (Odour), S1, S2, GW2, S-Odour, Plants and Soil Invertebrates, Mammals and Birds.



	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	
1		**Soil Components for Table 2 - Full Depth, Potable Water Scenario**														**Soil**
2		**Coarse Textured Soil**		**Residential /Parkland Land Use (ug/g)**												**Coar**
5	Soil Odour		MOE	Mass.	Ont. Soil	Plants &	Mammals	Soil Contact	Soil Leaching		Indoor Air	Indoor Air	Outdoor Air	Free Phase	Soil Odour	
6	S-Nose	Chemical Parameter	Soil RL	PQL	Bkgrd	Soil Org.	& Birds	S1 Risk	S-GW1	S-GW3	S-IA	Odour		Threshold	S-Nose	
63		Dieldrin	0.05		0.05	0.044	0.00096	0.94	3.1	0.11				9400		Dield
64		Diethyl Phthalate	0.5		0.5	11	85	94000	2300	0.071				8100		Dieth
65		Dimethylphthalate	0.5		0.5	17		94000	1500	0.024				1900		Dime
66		Dimethylphenol 2 4-	0.2		0.2			420	38	400				57000		Dime
67		Dinitrophenol, 2,4-	2		2			38	2.1	59				13000		Dinitr
68		Dinitrotoluene 2,4 & 2,6-	0.5		0.5			0.92	0.015	15				4300		Dinitr
69		Dioxane - 1,4	0.2		0.2		1.8	72	5.7	1000	210		69000	110000		Dioxa
70		Dioxin/Furan (TEQ)		5.4E-07	0.000007		0.000013	0.000048	0.0018	780	0.0028		0.11	7400		Dioxi
71		Endosulfan	0.04		0.04	0.15	0.023	38	110	0.46				9400		Endo
72		Endrin	0.04		0.04	0.019	0.0011	4.7	18	0.071				5000		Endri
73	5.2	Ethylbenzene	0.05		0.05	55	90	2100	1.2	17	2	100	8200	3100	5.2	Ethyll
74	52	Ethylene dibromide	0.05		0.05			0.22	0.0051	90	0.0015	1600	0.11	2100	52	Ethyl
75		Fluoranthene	0.05		0.56	50	0.69	7.8	24	40000	250		2500	8100		Fluor
76		Fluorene	0.05		0.12			720	1100	62				3200		Fluor
77	370	Heptachlor	0.05		0.05	0.2	3.9	0.15	66	1.8		19000		8900	370	Hept
78	180	Heptachlor Epoxide	0.05		0.05			0.11	6.6	0.0035		8800		5000	180	Hept
79		Hexachlorobenzene	0.01		0.01	100		0.52	2.9	14				10000		Hexa
80	8.6	Hexachlorobutadiene	0.01		0.01			7.1	0.53	1.6	0.014	210	3	8900	8.6	Hexa
81		Hexachlorocyclohexane Gamma-	0.01		0.01	5.9		0.25	11	0.057				5000		Hexa
82	0.46	Hexachloroethane	0.01		0.01			21	0.5	22	0.096	52	59	10000	0.46	Hexa
83		Hexane (n)	0.05		0.05					60	3.1		140000	1800		Hexa
84		Indeno[1 2 3-cd]pyrene	0.1		0.23	0.38		0.78	220	8.6E+13	46000		3200	8100		Inder
85		Lead	10		1.20	250	32	200						28000		Lead
86		Mercury	0.1		0.27	10	20	9.8	550	1.2E+14	0.25		39	39000		Mercu
87		Methoxychlor	0.05		0.05		0.13	0.38	32000	3.9				8500		Meth
88	29	Methyl Ethyl Ketone	0.5		0.5	35	9900	13000	200	280	19	910	52000	31000	29	Methy
89	1.8	Methyl Isobutyl Ketone	0.5		0.5			21000	440	160	7.4	44	26000	5900	1.8	Methy
90		Methyl Mercury **				0.8	0.034	2	1	0.0085				1300000		Methy
91		Methyl tert-Butyl Ether (MTBE)	0.05		0.05	25		440	1.9	260	0.89		170	9500		Methy
92	150	Methylene Chloride	0.05		0.05	0.78	350	110	5.2	8	0.11	720	2300	7100	150	Methy
93	0.99	Methlynaphthalene, 2-(1-) ***	0.05		0.59			72	30	77		34		4100	0.99	Methl
94		Molybdenum	2		2	40	6.9	110						26000		Molyb
95	4.5	Naphthalene	0.05		0.09	0.6	380	360	93	200	0.66	150	290	3200	4.5	Naph
96		Nickel	5		82	100	5000	330								Nicke
97		Pentachlorophenol	0.1		0.1	17	0.013	3.6	86	2.9				10000		Penta
98		Petroleum Hydrocarbons F1****	10		10	210		6900	4100	56	130		28000	2000		Petro
102		Petroleum Hydrocarbons F2	10		10	150		3100	4300	230	100		27000	3100		Petro
107		Petroleum Hydrocarbons F3	50		50	300		5800	20000					6200		Petro
112		Petroleum Hydrocarbons F4	50		50	2800		6100	1600000					7300		Petro
115		Phenanthrene	0.05		0.69	6.2	2700		17	270				2700		Phen
116	980	Phenol	0.5		0.5	17	9.4	5400	240	47	950	35000	14000	230000	980	Phen

Background Calculations | Primary Tables of Standards | Final Tables of Standards | **Tables of Drivers - Soil** | Tables of Drivers - Water | Drivers

Ready

11. If the driving component is “Mammals and Birds” or “Plants and Soil Organisms”, then you may wish to consider whether it would be appropriate for your site to use the “**Modified Ecological Protection**” (MEP) option (by picking “Y” from the pull-down menu in cell B30). This option will generate a higher number for the “plants and soil organisms” component, and effectively eliminate the “Mammals and Birds” component. An acknowledgement that the option has been chosen must be placed on the RSC. For a full description of this option, read **Appendix 4** of this document.

12. To this point, none of the options chosen would result in a Certificate of Property Use (CPU), so if your property meets the Tier 2 PSSs at this stage, then a RSC could be filed without a CPU. However, all further Tier 2 options available from the next step on would typically be associated with a CPU.

13. If your site soil still doesn’t meet the Tier 2 standards and the driving component is any of “Mammals and Birds”, “Plants and Soil Organisms”, S1, or S2, then you may wish to consider the use of either a “Shallow Soil Cap” or a “Fill Cap” or “Hard Cap”. These Risk Management Measures (RMMs) are described on the “RMM Descriptions”

tab of the model workbook. In the "Tier 2 Input" spreadsheet, clicking on one of the RMMs hyperlinked in blue (A31-A34) will take you to the appropriate description. Choose the option appropriate for your site by picking "Y" on the pull down menu in Cells B31 or B32 of the Tier 2 Input spreadsheet.

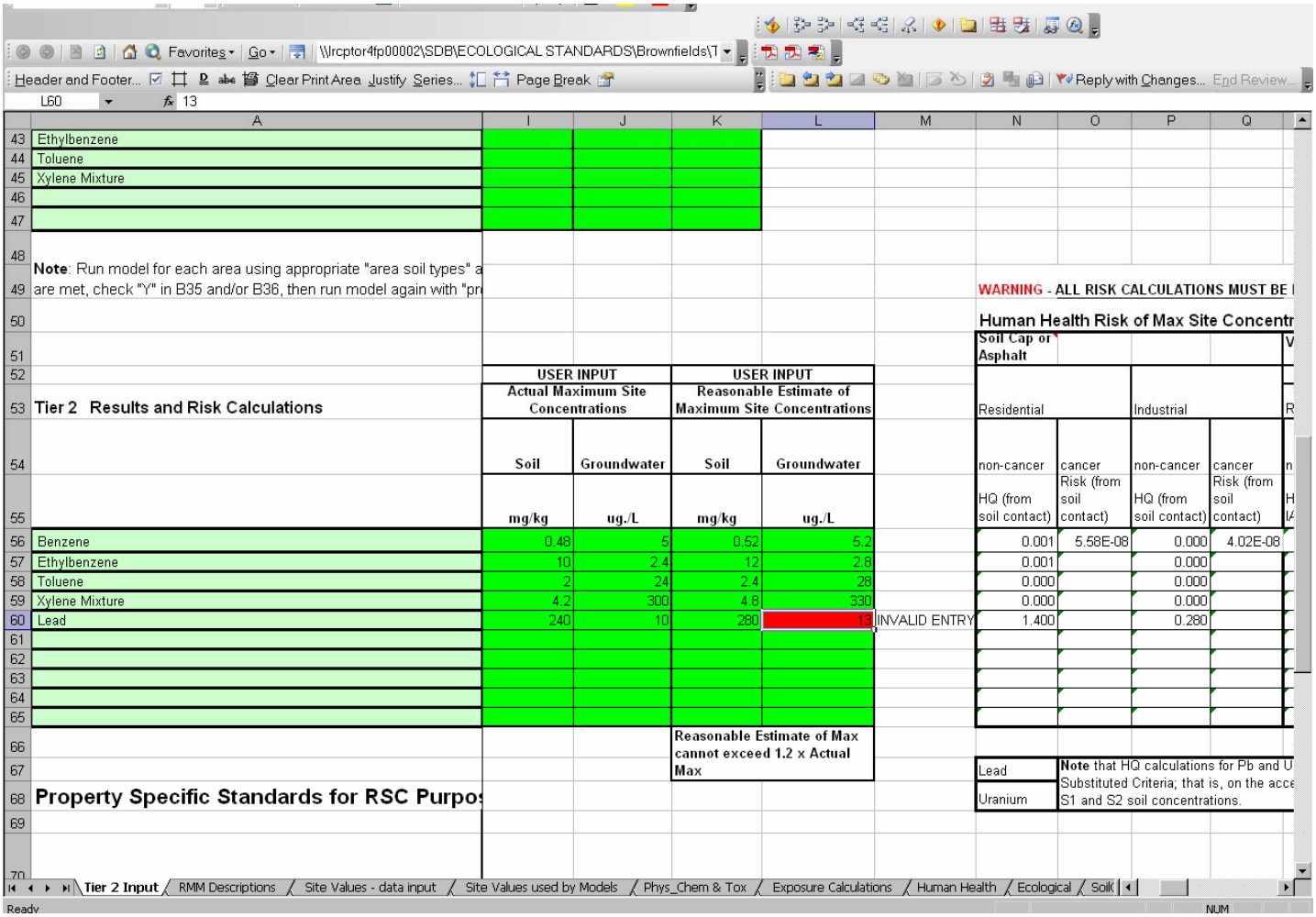
14. If your measured concentrations still exceed the Tier 2 PSS, and the driver is either S-IA or GW2, then you may wish to consider having a building with "Ground Level Non-residential" (choose "Y" in cell B34) or a "Storage Garage" (i.e. ventilated parking garage) or having "No Enclosed Buildings" (choose cell B33 for either). Note that the "Ground Level Non-residential" option can be used for a building that is entirely industrial or commercial if it is within an industrial or commercial area and the QP is confident that there will be no off-site residential concerns for the GW2 pathway.

15. Here are restrictions on how Risk Management Measures (RMMs), Modified Ecological Protection (MEP) and Soil Vapour Screening Levels (SVSLs) can be combined:
    - MEP and SVSLs can be combined with anything
    - "Fill Cap" & "Hard Cap" can be combined with one another
    - "Shallow Soil Cap" cannot be combined with either of the other caps
    - "Shallow Soil Cap" can only be used if land use is industrial/commercial/community
    - "No Enclosed Buildings" cannot be combined with buildings containing a "Storage Garage" or "Ground Floor Non Residential"
    - Buildings containing a "Storage Garage" or "Ground Floor Non Residential" should not be combined with one another in the model (the "Storage Garage" is always more protective; adding "Ground Floor Non Residential" would give no additional relief; it is fine to have both at the actual site)
    - Buildings containing a "Storage Garage" or "Ground Floor Non Residential" can be combined with caps; with the exception of shallow soil caps which cannot be used in a residential/parkland/institution landuse or agricultural landuse.

16. At this point, if you still don't meet all the Tier 2 PSSs generated by the above choices in the spreadsheet, you can proceed to conducting a full (Tier 3) RA and use the numbers generated above to reduce the amount of work required (e.g. reducing the number of chemicals or area of contamination) for a Tier 3 risk assessment, or remediate the contaminated areas that don't meet the PSSs developed above. If you do meet the PSSs after choosing any of the RMMs (A31–A34), then you may submit the risk assessment to the Ministry for approval using those PSSs (Cells B72-D81).

17. When an RMM has been used, it is necessary to report what the risk level would be if the RMM were to fail. These risk levels are calculated in the Tier 2 spreadsheet in cells I56-AV65. **Please note that they must be calculated with all the RMMs in cells B30 to B34 turned off** (set at N). Cells B35 and B36 can be set to Y for the risk calculations only if all the Soil Vapour Screening Criteria were met for all soil vapour

samples. The screenshot below shows the user input area (note the invalid entry where a reasonable estimate of the site maximum entered is higher than 1.2 times the actual measured value) and the first part of the risk calculations. Determine the risk level by looking under the appropriate risk management measure in Row s 51. The cancer risk level is given for carcinogens and the Hazard Quotient from each particular exposure component (e.g. soil contact).

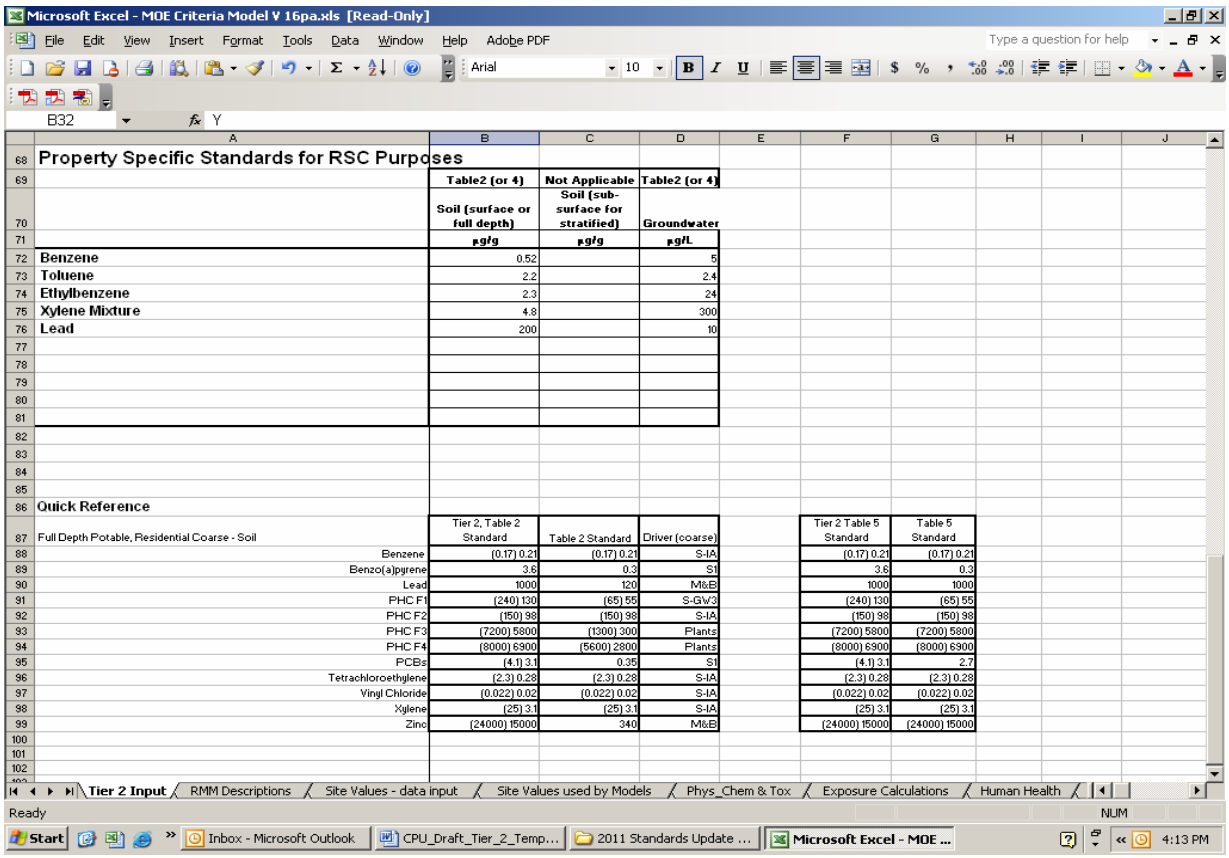


	A	I	J	K	L	M	N	O	P	Q
43	Ethylbenzene									
44	Toluene									
45	Xylene Mixture									
46										
47										
48										
49	**Note**: Run model for each area using appropriate "area soil types" a						WARNING - ALL RISK CALCULATIONS MUST BE			
50	are met, check "Y" in B35 and/or B36, then run model again with "pr						Human Health Risk of Max Site Concentr			
51							Soil Cap or Asphalt			V
52		USER INPUT		USER INPUT						
53	**Tier 2 Results and Risk Calculations**	Actual Maximum Site Concentrations		Reasonable Estimate of Maximum Site Concentrations			Residential		Industrial	R
54		Soil	Groundwater	Soil	Groundwater		non-cancer	cancer	non-cancer	cancer
55		mg/kg	ug./L	mg/kg	ug./L		HQ (from soil contact)	Risk (from soil contact)	HQ (from soil contact)	Risk (from soil contact)
56	Benzene	0.48	5	0.52	5.2		0.001	5.58E-08	0.000	4.02E-08
57	Ethylbenzene	10	2.4	12	2.8		0.001		0.000	
58	Toluene	2	24	2.4	28		0.000		0.000	
59	Xylene Mixture	4.2	300	4.8	330		0.000		0.000	
60	Lead	240	10	280	13	INVALID ENTRY	1.400		0.280	
61										
62										
63										
64										
65										
66				Reasonable Estimate of Max cannot exceed 1.2 x Actual Max						
67							Lead	Note that HQ calculations for Pb and U Substituted Criteria; that is, on the acce		
68	**Property Specific Standards for RSC Purpos**						Uranium	S1 and S2 soil concentrations.		
69										
70										

Tier 2 Input | RMM Descriptions | Site Values - data input | Site Values used by Models | Phys_Chem & Tox | Exposure Calculations | Human Health | Ecological | Soil

Ready NUM

The next screenshot shows the area of the Tier 2 Input spreadsheet that displays the final Tier 2 PSSs. There is also an area (cells B86-B99) that gives a quick reference comparison for some common contaminants such that you can quickly see the effects of your Tier 2 changes in comparison to the Generic Table 2 Residential coarse soil standards.



Limitations of the Approved Model

There are some standards for which no Tier 2 adjustments or RMMs will alter the SCS. For example, any potable GW SCS that is driven by drinking water is not changeable under the Approved Model. Similarly, any soil SCS that is driven by an S3 (subsurface worker human health direct exposure) is also not changeable under the Approved Model.

Any of the conditions for which the generic assumptions may not hold would result in a violation of the assumptions behind the Approved Model as well. These are repeated from the introduction to the generic standards as follows:

Conditions can exist at a site for which the assumptions used to develop the generic criteria may not be valid. The QP must ascertain that the site conditions are appropriate for use of the generic standards such that he/she can be comfortable with signing the certifications on the RSC. To assist the QP in recognizing the types of conditions that may be important in this respect the following examples are given:

a) if the contaminated zone has a volume larger than 340m^3 or a source length or width greater than 13 metres then all pathways which employ source depletion or ground water transport (Soil to Nose, S-GW1, S-IA, S-GW3 and GW3 components of the standards) may be affected.

b) if a high permeability zone is present in the vadose zone which provides a direct

preferential pathway to the building then the soil properties assumed in the generic J&E modelling to determine the S-IA and GW2 components of the standard may change.

c) if the annual average of the capillary fringe of the water table is < 0.8 metres from the outer edge of the gravel crush of the building foundation, then the 10 x biodegradation factor assumed in the GW2 pathway for some VOCs may be non-conservative.

d) if the average Organic Carbon content (foc) of soil above the water table is < 0.002 then more contaminant may be in the water and gas phases than assumed in the generic standards.

f) if there is a continuous source of the contaminant then the pathways which assume a depleting source (i.e., S-IA, S-GW1, and Soil to Nose) might be non-conservative.

g) if there is a surface water body that could be affected by the property from contaminant migration via ground water, and the surface water has total hardness less than 70 mg/L (as $CaCO_3$) and/or has pH less than 6.7, the aquatic protection values for some metals and pentachlorophenol may be non-conservative. In such cases, the QP may need to consider whether a site-specific estimate of hardness and pH resulting from mixing of ground water and surface water is needed to estimate an appropriate aquatic protection value for this site.

The existence of any of the above conditions does not necessarily indicate that the Tier 2 PSSs are not valid for a given site. There are many interrelated parameters and factors that were used in the development of the generic standards, and in many cases one factor, such as any of those above, can be outweighed by differences in other factors in a manner that, overall, there is sufficient natural protection provided by the site. In addition, it must also be considered that the component that drives the standard may not be affected by the particular limiting condition described above (e.g. a terrestrial ecological driver, but there are high permeable zones in the vadose zone). The QP should consider these types of factors in assessing the appropriateness of the use of the Tier 2 PSSs.

Once you have completed the above steps and are satisfied with risk assessment you can submit it to the Ministry by completing the "Template for Risk Assessment Reports Based Entirely on Use of The Approved Model Version 1.0" (7887e01)**.** As the title suggests, this template is only for use when submitting a risk assessment based only on the Approved Model. This template and other publications, including a Technical Update (June 2011), which outlines the process for submission of a MGRA is on the following site (http://www.ene.gov.on.ca/environment/en/subject/brownfields/STDPROD_075745.

For more information on Tier 2, contact the Streamlined Risk Assessment Coordinator at Standards Development Branch of the Ontario Ministry of the Environment (E-mail: SDB-Tier2RAReview@ontario.ca; Phone 416-327-5519).

Appendix 1 Determination of Soil Type

Use the results of the soil texture analyses to determine which soil type is appropriate by placing the % sand and % silt (or clay) in the following triangle. . The point of intersection of the two lines gives the Soil Type. The triangle is from Figure 3-16 of the Soil Survey Manual, United States Department of Agriculture, Natural Resources Conservation Service, as published at its website. See
http://soils.usda.gov/technical/manual/print_version/chapter3.html for more information, or
http://soils.usda.gov/technical/aids/investigations/texture/ for an exact calculator.

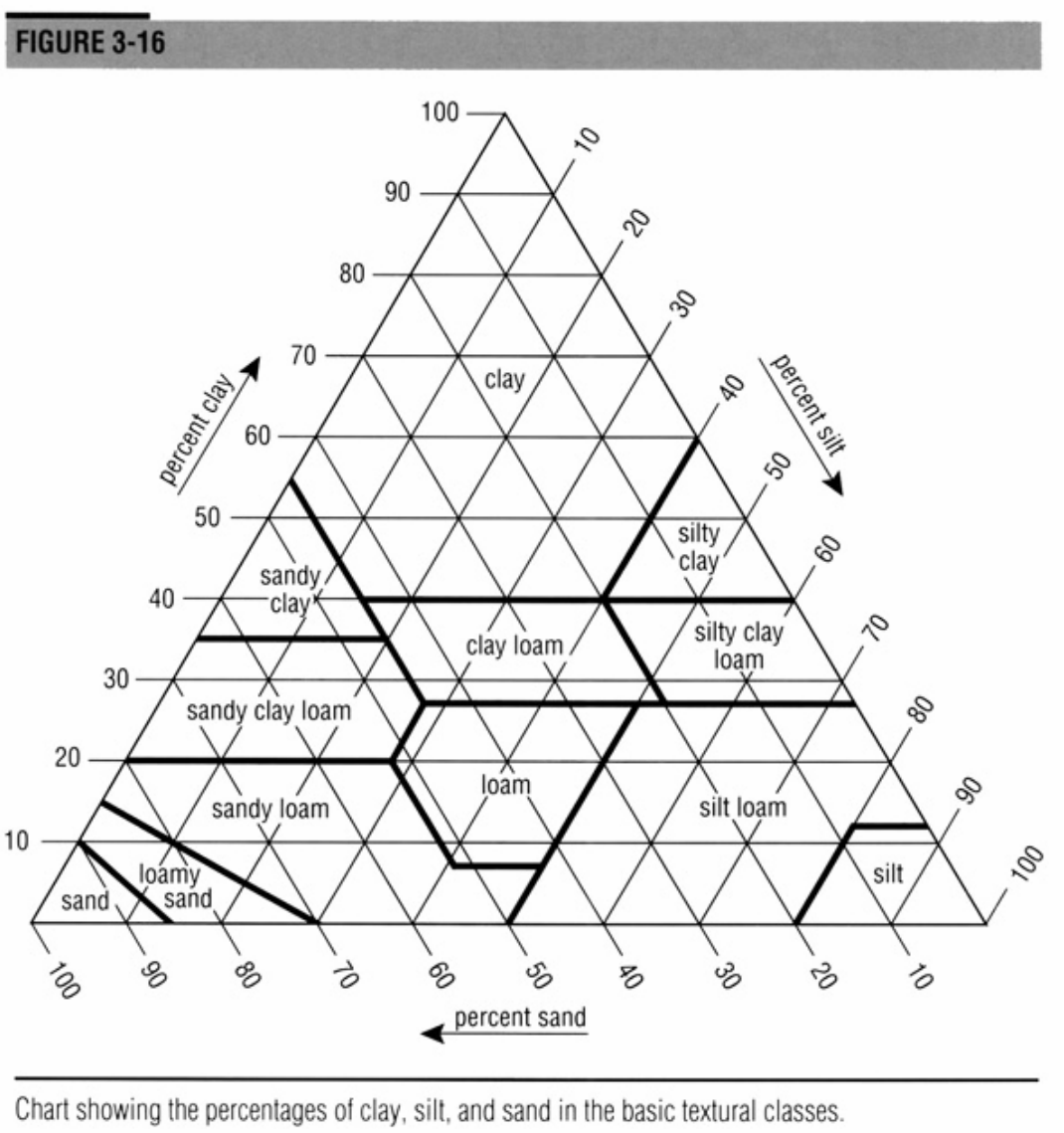


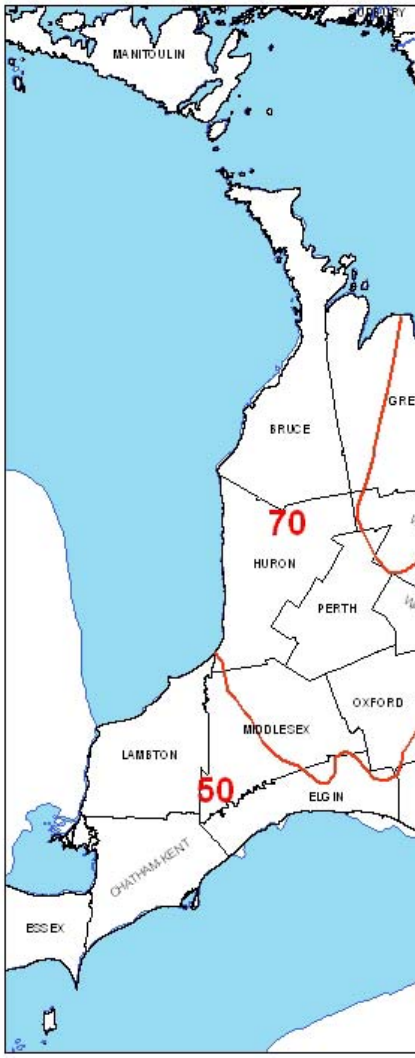
Chart showing the percentages of clay, silt, and sand in the basic textural classes.

USDA classification

Sand - Soil particles between 0.05 and 2.0 mm in size
Silt - Soil particles between 0.002 mm and 0.05 mm
Clay - Soil particles smaller than 0.002 mm (2 microns) in size

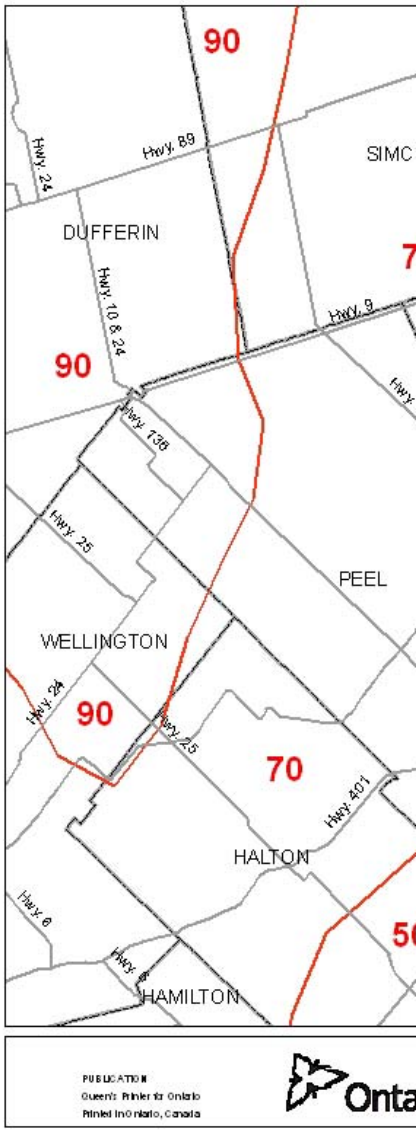
Appendix 2 Maps Showing "Number of Frozen Ground Days Per Year"

A1 – Southern Ontario



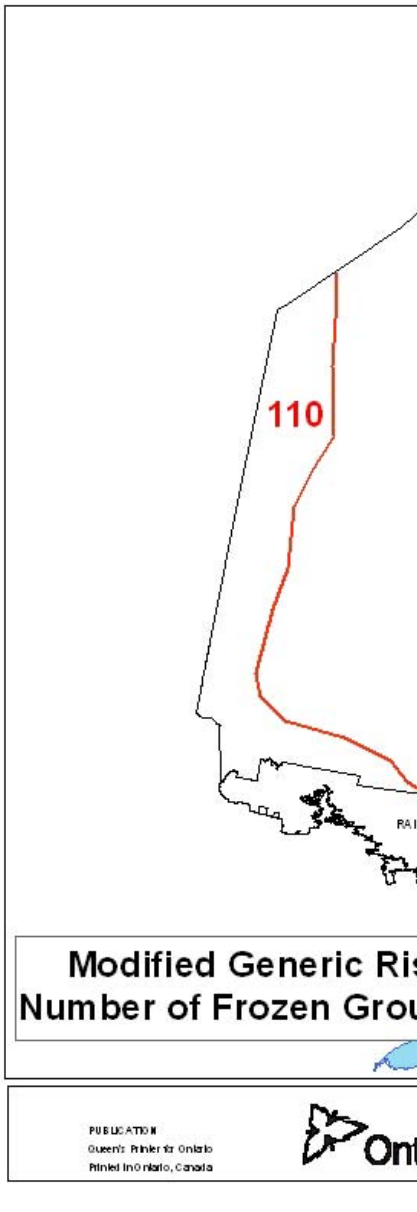
PUBLICATION
Queen's Printer for Ontario
Printed in Ontario, Canada

A2 – Greater Toronto Area



B – Central Ontario

C – Northern Ontario



Appendix 3: Chart to identify which Tier 2 input parameters affect which pathways (subsurface transport components)

Pathway\Tier2 Input Parameters	S-IA*	S- Odour	S-GW1	S-GW3	S-OA	GW1	GW2	GW3	Free Phase Threshold
Distance to surface water	NA	NA	NA	✓	NA	NA	NA	✓	NA
Soil FOC – water table to soil surface	✓	NA	✓	✓	✓	NA	NA	NA	✓
Soil FOC – upper 0.5m	NA	✓	NA	NA	NA	NA	NA	NA	NA
Depth to water table	NA	NA	NA	NA	NA	NA	✓	NA	NA
Property Soil Type – vadose zone	✓	✓	✓	✓	✓	NA	✓	NA	✓
Property Soil Type – capillary fringe	NA	NA	NA	NA	NA	NA	✓	NA	NA
# Frozen Days	NA	✓	NA	NA	NA	NA	NA	NA	NA
Aquifer horizontal hydraulic conductivity	NA	NA	NA	✓	NA	NA	NA	✓	NA
Aquifer horizontal hydraulic gradient	NA	NA	NA	✓	NA	NA	NA	✓	NA
Aquifer dry bulk density	NA	NA	NA	✓	NA	NA	NA	✓	NA
Aquifer FOC	NA	NA	NA	✓	NA	NA	NA	✓	NA

* Best method to do Tier 2 on S-IA pathway is using soil vapour screening methods as described in the body of this document.

NA = not applicable for pathway; ✓ = applicable for pathway

Descriptions of all Components

GW1 – Ground water for drinking water purposes

GW2 – Ground water for protection from movement to indoor air

GW3 – Ground water for protection of aquatic life

S1 – Soil for protection of a residential receptor from direct contact with surface soil

S2 – Soil for protection from direct soil contact for a lower frequency and intensity exposure than residential surface soil, such as for commercial or industrial scenarios where children are not frequently present.

S3 – Soil for direct soil contact for a low-frequency, high-intensity, human health exposure scenario without children present that is protective of a worker digging in the soil.

S-IA –Soil for protection of movement to indoor air and human exposure.

S- OA – Soil for protection of movement to outdoor air and human exposure

S-Odour – Soil for protection from excessive odours

S-GW1 – Soil for protection from movement to ground water for drinking water purposes

S-GW3 – Soil for protection from movement to ground water and then to aquatic life

Plants and Soil Organisms – Soil for protection against adverse effects to plants and soil dwelling organisms

Mammals and Birds – Soil for protection against adverse effects through direct soil and food ingestion to mammals and birds

Appendix 4: Tier 2 Option: Modified Ecological Protection (MEP)

1) What is the Tier 2 modified ecological protection (MEP) option?

In order to allow the development and application of less stringent Property Specific Standards (PSS), current practice in Ontario is to remove ecological habitat to ensure no ecological species are present or exposed to contamination. This practice results in the removal of habitat which, although degraded, could and often does support a variety of ecological species. While redevelopment needs may drive the removal of habitat, the ministry's intent is to provide another option that will allow for greater preservation of ecological habitat. The ministry has developed a "modified ecological protection (MEP)" option within the Approved Model, which is intended to both promote brownfield redevelopment and preserve existing and potential future ecological habitat. This means getting more brownfield properties developed and providing developers a greener alternative to paving over ecological habitat. The ministry will continue to look at new ways of promoting ecological habitat preservation as part of brownfield redevelopment.

Modified ecological protection (MEP) is an option available to risk assessors within the modified generic risk assessment process) in Ontario that uses less stringent ecotoxicity values to develop property specific standards (PSS). The use of the MEP option will allow for the maintenance or establishment of natural habitat; habitat that is not comparable in quality to habitat in an uncontaminated setting but instead is habitat comprising of assemblages of species that are adapted or less sensitive to the contaminants of concern at the property. Use of the MEP option may result in adverse effects to some plants, soil organisms and wildlife that might reside in or frequent the site. The MEP option does provide the **same degree of protection to humans** as the Tier 1 generic standards.

Under the MEP option, ecotoxicity values for mammals and birds are removed from the modified generic model for both residential/parkland and commercial/industrial land uses. Therefore no protection is provided for those ecological receptors under the MEP option. For plants and soil invertebrates under both residential/parkland and commercial/industrial land uses, the Tier 2 MEP option utilizes a multiplier (1.9 x industrial component value) that is equivalent to the 75^{th} percentile value for each dose-response data set (developed for generic model values using the CCME protocol weight-of-evidence procedure where resulting No Observable Effect Concentration (NOEC) and Lowest Observed Effect Concentration (LOEC) data are ranked and ranked percentiles are determined for each data point).

2) What is the purpose of the MEP option?

The MOE recognizes that maintaining natural environments on remediated brownfield sites should be encouraged wherever possible. Soil standards at a brownfield site can often be driven by ecological risks to soil-dwelling invertebrates, plants and wildlife; therefore, "paving" a site as a means of removing potential ecological risks is one option that is exercised by property owners. However, paving a site provides no opportunity for any current or future natural habitat to exist on a property.

The MEP option in MGRA will provide the property owner with a viable alternative to risk management measures such as "paving". The MEP option will allow the property owner to use ecotoxicity values that will yield less stringent Property Specific Standards (PSS) values that can support a natural but relatively degraded environment; however it also may result in adverse effects to some plants and soil organisms. As a result, some species may not thrive as they would have at a site that is uncontaminated or which meets the more stringent generic site condition standards. However, more robust species will have the opportunity to populate this habitat which provides a more ecologically sustainable alternative to paving a site and promotes the redevelopment of brownfield properties.

3) Degree of protection provided by the MEP option

It is important to note that unlike other options for modifying the generic assumptions in the Approved Model (i.e., through the input of site-specific parameters into model inputs or the use of standardized risk management measures) use of the MEP option does *not* provide the same degree of ecological protection that is provided by the Tier 1 generic standards. Instead a lower degree of ecological protection is permitted under the MEP option and adverse effects to some portions of ecological receptor populations may be anticipated in many cases. However, the MEP option *does* provide the same degree of protection to humans as the Tier 1 generic standards.

The MOE acknowledges that at some sites the higher soil concentrations allowed under the MEP option might not cause adverse ecological impacts due to ameliorating site-specific conditions (e.g., decreased bioavailability due to soil physicochemical characteristics or due to the site-specific speciation of the contaminant(s), differential sensitivity of species at a site relative to those used to generate ecotoxicity values, plasticity or adaptation of the species at the site, etc.). Therefore, use of the MEP option may not result in adverse ecological impacts. Should a property owner need to demonstrate that no adverse ecological impacts have resulted from leaving concentrations of contaminants using the MEP option a Tier 3 risk assessment must be conducted.

Note on human health exposure pathway through ingestion of plants

The Tier 2 MEP option is available for all land uses except agriculture. The model under the Tier 2 MEP option incorporates all of the same assumptions and exposure pathways for soil contaminants for the protection of human health as the Tier 1 generic model. Therefore, the MEP option provides the same degree of protection to humans as the Tier 1 generic standards. However, the Tier 1 model (and therefore the Tier 2 spreadsheet) does not incorporate the soil-to-plant uptake-to-human ingestion pathway. This is because the current state of the science is very uncertain and excessive conservatism may be required in order to cover all uncertainties, especially with respect to modelling soil-to-plant uptake values in a scientifically defensible manner. There is an enormous amount of variability in the rate of bioaccumulation of individual contaminants in plants in the scientific literature. Uptake factors can vary by orders of magnitude among species and even within subspecies and varieties. Under the Tier 2 MEP option, soil concentrations at the 75^{th} percentile are not in a range anticipated to cause significant phytotoxicity. Therefore, plants grown at these concentrations would likely survive and have the potential to be used as a food item (the same is true for plants grown in soil under generic Tier 1 conditions). Because there is a potential that plants that

might be ingested by humans accumulate higher concentrations of contaminants under the Tier 2 MEP option compared to plants grown in soil with contaminant concentrations at the Tier 1 generic standards, the Tier 2 MEP option is not permitted under agricultural land uses. It is also not permitted for agricultural land uses because decreased protection of plant life is incompatible with agricultural land use. The exclusion of the soil-to-plant uptake-to-human ingestion exposure pathway in the generic model is an acknowledged gap and will be re-evaluated at a future date once the scientific data supporting the development of this pathway into the generic model becomes available.

4) How is the MEP option used within Tier 2?

MEP is an option available to the QP_{RA} in a similar fashion as the Tier 2 adjustable input parameters and risk management measures options. If a QP_{RA} wishes to invoke the MEP option for a site, they simply select the "Modified Ecological Protection" option in the Tier 2 spreadsheet. The Tier 2 spreadsheet then recalculates the PSS based on the modified ecological values under the MEP (as well as any other changes in the model if other Tier 2 adjustable parameters have been modified by the QP_{RA}).

5) How is the MEP option reported?

Any RSC that utilizes standards that were developed with the MEP option will state such on the RSC itself that will be posted on the Brownfields Environmental Registry for public viewing.